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(71) Applicant: MARDON ILLINGWORTH LIMITED
Forest Works Coxmoor Road
Sutton-in-Ashfield Nottinghamshire(GB)

(72) Inventor: McKie, Richard McCormick
3 Newlands Drive Forest Town
Mansfield Nottinghamshire(GB)

(72) Inventor: Vardy, Edward Anthony
25 Searby Road
Sutton-in-Ashfield Nottinghamshire(GB)

(72) Inventor: Winterton, Michael
5 Round Hill Close
Sutton-in-Ashfield Nottinghamshire(GB)

(72) Inventor: Haskew, Michael
89 Quarry Road
Ravenshead Nottinghamshire(GB)

(72) Inventor: Price, Frank
39 Medan Bank Stanton Hill
Sutton-in-Ashfield Nottinghamshire(GB)

(72) Inventor: Whetton, Geoffrey
18 Clumber Street
Kirkby-in-Ashfield Nottinghamshire(GB)

(72) Inventor: Rhodes, Philip
88 Hamilton Drive Stonebridge Park Estate
Warsop, Nottinghamshire(GB)

(72) Inventor: Cook, John Alan
200 Leeming Lane, North
Mansfield Woodhouse Nottinghamshire(GB)

(72) Inventor: Warren, John Keith
4 Hallifax Avenue
Church Warsop Mansfield Nottinghamshire(GB)

(74) Representative: MacGregor, Gordon et al,
ERIC POTTER & CLARKSON 14 Oxford Street
Nottingham, NG1 5BP(GB)

(54) **Cup-shaped containers and method and apparatus for manufacturing them.**

(57) A cup-shaped container is formed from a metal blank (13) by forcing the blank (13), carried by a mandrel (50) through a drawing die (21) to shape the blank (13) with a base (14) and an elongate cylindrical wall (15), and ironing dies (22,23) to thin and extend the cylindrical wall (15) along the mandrel (50). The mandrel (50) has circumferential a groove (57) into which metal is caused to flow during the ironing step and adjacent the groove (57) is a severing die (56) which co-operates with an ironing die (23) to trim the rim of the cylindrical wall (15) adjacent the groove (57). The resultant container has an inner circumferential bead (60) at the rim, which strengthens the container and reduces the incidence of splitting.

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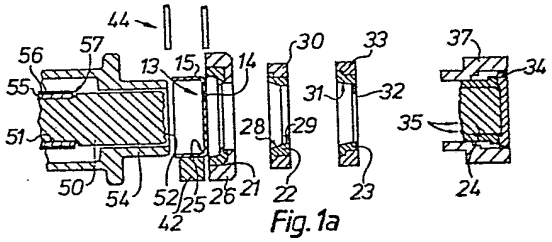
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Fig. 1a

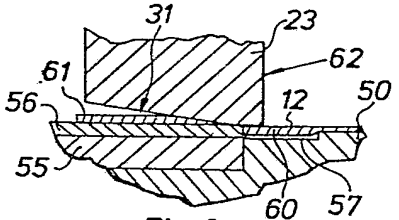
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Fig. 2

TITLE MODIFIED
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MANUFACTURE OF CUP-SHAPED CONTAINERS.

This invention relates to a cup-shaped container, a method of making such a container and apparatus for carrying out the method.

Cup-shaped containers made of metal are commonly used to make cans for containing and storing foods and liquids. There are two main types of such cans. Firstly, there is the traditional three-piece can comprising a cylindrical body rolled from a sheet of metal and seamed down the side. This body is capped at one end by a separate disc-shaped base, made of sheet metal and crimped and seamed to the cylindrical body, to form a cup-shaped container. After filling of the container, the opposite end of the body is similarly capped.

In recent years there has been developed a two-piece can, sometimes referred to as a "seamless" can, wherein the body and the base are integrally formed by drawing and wall-ironing from a blank of metal, to form a one-piece cup-shaped container, which is trimmed at the rim and finally capped after filling. It is usual for such a cup-shaped container to be made in three operations. A shallow cup-shaped blank is formed in a first operation from a flat blank. This shaped blank is then subjected to drawing and wall-ironing and the third operation is cutting off the rim margin with a knife to form a cup - shaped container of standard length. Such cans have the advantages that leakage and consequent food contamination are less likely to occur, since seams are considerably reduced as compared with the traditional can. In addition, the two-piece cans are more aesthetically pleasing to the eye and are easier to stack end to end.

A problem that arises in the manufacture of the one-piece cup-shaped containers is that longitudinal splits occasionally develop in the cylindrical wall of the container. Such splits, if not detected, may result in a can which is liable to leakage and contamination of the contents. Variation occurs in quality of the metal used for making cans and this problem manifests itself particularly with poorer quality metal.

It has now been found that these splits begin at the rim and spread along the body wall of the cup-shaped container and it has surprisingly been discovered that the incidence of splitting can be very considerably reduced by forming an area of increased strength adjacent the rim.

The present invention provides a method of manufacturing a one-piece cup-shaped container, comprising wall-ironing a blank having a base and a cylindrical wall, so as to extend the length of the cylindrical wall, forming an integral inner circumferential bead on the cylindrical wall towards the end of the wall-ironing operation, and trimming the rim of the cylindrical wall near the bead. Preferably, the trimming step is effected by continuing the wall-ironing operation past a cutting edge.

It has been found that the formation of this bead, which may project by only 0.06 mm for example, strengthens the rim sufficiently to reduce very considerably the incidence of splitting of the cylindrical wall.

It is preferred that the trimming step is carried out immediately adjoining the bead. This reduces the risk of the trimming step inducing splits in the rim of the container.

Preferably the drawing, wall-ironing and trimming steps are carried out sequentially by means of a punch which forces the blank through drawing, wall-ironing and trimming dies and serves as a mandrel. This permits very rapid manufacture of the cup-shaped container.

The forming of the bead is preferably effected by the wall-ironing step causing material of the cylindrical wall to flow into a groove around the mandrel.

The invention also resides in wall-ironing apparatus for use in manufacturing a one-piece, cup-shaped, metal container from a pre-shaped blank having a base and a cylindrical wall, the apparatus comprising a mandrel insertable within the cylindrical wall and an annular wall-ironing die for ironing the cylindrical wall along the mandrel to extend the length of the cylindrical wall, characterised in that a circumferential groove is provided around the mandrel near the rim-forming portion of the mandrel, whereby an integral inner circumferential bead is formed on the cylindrical wall near the rim by relative movement of the mandrel and the ironing die.

The apparatus preferably includes trimming means provided near the groove co-operable with the wall ironing die for trimming the rim of the extended cylindrical wall. The trimming means, advantageously, has a trimming edge radially aligned with an edge of the groove, so that the bead immediately adjoins the free end of the trimmed cylindrical wall.

The invention also resides in a one-piece metal, cup-shaped container having a base and an integral elongate cylindrical wall, in which the cylindrical wall has been extended by wall-ironing and trimmed to provide a container of predetermined length, the cylindrical wall having an integral inner circumferential bead formed near the rim.

Reference is now made to the accompanying drawings, wherein :-

Figure 1a to 1e are sectional views of parts of apparatus for manufacturing a cup-shaped container, showing various steps during such manufacture;

Figure 2 is an enlarged view of a part of the apparatus in the position shown in Figure 1e; and

Figure 3 is a perspective view of the apparatus showing the input of blanks and output of up-shaped containers.

The apparatus shown in the Figures is for manufacture of a one-piece, cup-shaped, steel container suitable for making a can. The container 10, as shown in Figure 1e and 3 comprises a base 11 and an integral cylindrical wall 12. To make a can, the container is further processed to form an outstanding flange at the rim and, after filling, a lid is sealed to the rim.

The container is made from a dish-shaped blank 13, as shown in Figures 1a, and 3, which is preformed by a drawing step from a flat blank of low-carbon, cold rolled, tin-coated steel in known manner. This blank has a base 14 and a shallow cylindrical wall 15. The apparatus carries out a series of forming steps in rapid succession to form a container 10.

The apparatus comprises a body 20 (Figure 3), which mounts in fixed, spaced locations, a drawing die 21, a first wall-ironing die 22, a second wall-ironing die 23 and an impression die 24 (Figure 1a).

The drawing die 21 is annular and formed with an inner circumferential radiussed rebate 25, which snugly receives the base 14 of a blank 13, as shown in Figure 1a. The drawing die 21 is supported by an outer ring 26 of complementary form.

The first wall-ironing die 22 is annular and has a frusto-conical inner surface 28 leading to a cylindrical, inner surface 29 of slightly smaller diameter than that of the drawing die 21. The die 22 is supported by an outer ring 30.

The second wall-ironing die 23 is similarly annular and has a frusto-conical inner surface 31 leading to a cylindrical, inner surface 32 of slightly smaller diameter than that of the first wall-ironing die 22. The die 23 is supported by an outer ring 33.

The impression die is a block held in a recess in a cup 34 and formed with circular depressions 35. The cup 34 is slidable in a housing 37 under pneumatic pressure. The rings 26, 30, 33 and the housing 37 are fixed in the body 20 (Figure 3) which has an inlet 40 for blanks 13 and

an outlet (not shown but located beneath the gap between the second wall-ironing die and the block 35) for the containers 10.

Beneath the outlet is a conveyor 41 for removing the containers. Beneath the inlet (as shown in Figure 1a) is a cradle 42 into which the blanks 13 are fed gravitationally and individually. A guide 44 receives the blanks and means (not shown) is provided in known manner for catching the blanks and releasing them individually.

The apparatus includes a mandrel (or punch) 50 of cylindrical form and fixed to a hollow piston rod 55 which may be reciprocated by a hydraulic ram (or mechanical crank). The mandrel has an end face 52 formed complementary to the formations 35 on the impression die 24. The mandrel is received within a sleeve 54, there being an annular gap between the mandrel and the sleeve. The sleeve is slidable on a piston (not shown) to which the piston rod is secured. The outer surface of the piston rod 55 supports a severing die 56. The severing die has a sharp edge formed adjacent an annular groove 57 around the mandrel. The groove is defined by a rebate in the mandrel and an end wall of the piston rod 55 supporting the severing die 56, so that the sharp edge thereof is radially aligned with an edge of the groove.

The sleeve 54 is complementary to the rebate 25 in the drawing die 21 and is advanceable to engage in this rebate. The sleeve may, in known manner, have a resilient connection with the piston (not shown), so that on advancement of the piston to advance the mandrel, the sleeve is advanced until it is stopped by engagement with the drawing die, when the resilient connection permits continued movement of the mandrel.

In operation, the mandrel 50 is advanced together with the sleeve 54 towards and into engagement with a blank 13

held in the cradle 42. The sleeve and the mandrel enter the open end of the blank and the sleeve deforms the cylindrical wall 15 of the blank and urges it against the rebated wall of the drawing die 21. The mandrel 50 continues to move relative to the sleeve 54 and pushes the blank through the drawing die, so that the blank is reshaped to the mandrel with a base of reduced diameter a cylindrical wall of increased length. This process is illustrated in Figure 1b.

The mandrel 50 continues to advance and forces the re-shaped blank 13 through the first wall-ironing die 22. This process thins and lengthens the cylindrical wall of the blank along the mandrel, as is apparent from Figure 1c. The mandrel continues to force the blank through the second wall-ironing die 23, as shown in Figure 1d, and this further thins and lengthens the cylindrical wall to its final length.

Finally the cup 34 is pneumatically moved in the housing 37 to urge the impression die 24 against the end 52 of the mandrel (as shown in Figure 1e), to form circular ridges in the base.

As the mandrel 50 comes to the end of its movement, the frusto-conical surface 31 of the second wall-ironing die co-operates with the sharp edge of the severing die 56 to trim a rim portion of the cylindrical wall, so that the wall is cut to a predetermined length.

Before the severing step occurs, the second wall-ironing die causes the metal of the cylindrical wall 12 of the container to flow into the groove 57, so that an inner bead is formed around the rim of the container. The cylindrical wall is severed immediately adjacent the bead. Figure 2 more clearly shows the formation of this bead 60 and the severing step, which removes a trim 61.

The mandrel 50 is then retracted and the inherent resilience of the container 10 causes the cylindrical wall to open out slightly, so that the bead 60 is retracted from the groove 57 and the rim engages the end face 62 of the second wall-ironing die, thereby preventing retraction

of the container. The container falls through the outlet onto the conveyor 41 and the trim 61 also falls away into a collection bin.

The depth of the groove 57 is, preferably, sufficient to permit formation of a bead 60, which stands proud of the cylindrical wall 12 by 0.06 to 0.07 mm. The width (i.e. the dimension parallel to the container axis) of the groove and of the bead is between 0.7 and 1.5 mm and preferably about 1 mm.

The severing, or trimming step may be carried out in a separate operation on a separate trimming machine.

The provision of the bead is extremely important in preventing the container from beginning to split longitudinally from the rim. The bead significantly increases the rim strength without noticeably increasing the weight of the container. It is possible, therefore, for a container to be made with thinner walls than is usual without any greater risk of splitting.

A number of containers made according to the above process were tested for splitting by placing the open end of each on a 60° cone and applying an increasing compressive force to the can until the can split at the rim. Comparative tests were carried out on a similar number of similar cans which were not provided with beads at their rims. The means and standard deviations of the tests are tabulated below :

	No. of cans tested	Mean value of splitting force (in Kg)	Standard Deviation of splitting force
Standard can (i.e. without bead)	12	256.7	28.4
Improved can (i.e. with bead)	11	301.2	21.6

The increase in the mean value from 256.7 to 301.2 is signifcant at the 0.1% probability level.

The invention may be applied to cans of materials other than tin coated steel, such as aluminium or aluminium alloy.

CLAIMS.

1. A method of manufacturing a one-piece, cup-shaped metal container, comprising wall-ironing a pre-shaped blank having a base and a cylindrical wall, so as to extend the length of the cylindrical wall, characterised by forming an inner circumferential bead on the cylindrical wall towards the end of the wall-ironing operation, and trimming the rim of the cylindrical wall near the bead.

2. A method according to claim 1, wherein the wall-ironing operation is effected by relatively moving an annular ironing die and a mandrel on which the cylindrical wall is ironed, characterised in that a groove is provided around the mandrel so that material of the cylindrical wall flows into the groove to form the bead during the last part of the wall-ironing operation.

3. A method according to claim 2, characterised in that the wall-ironing operation is continued after formation of the bead past a cutting edge to effect said trimming.

4. Wall-ironing apparatus for use in manufacturing a one-piece, cup-shaped, metal container from a pre-shaped blank having a base and a cylindrical wall, the apparatus comprising a mandrel insertable within the cylindrical wall and an annular wall-ironing die for ironing the cylindrical wall along the mandrel to extend the length of the cylindrical wall, characterised in that a circumferential groove is provided around the mandrel near the rim-forming portion of the mandrel, whereby an integral inner circumferential bead is formed on the cylindrical wall near the rim by relative movement of the mandrel and the ironing die.

5. Wall-ironing apparatus according to claim 4 characterised by trimming means provided near the groove and co-operable with the wall-ironing die for trimming the rim

of the extended cylindrical wall.

6. Wall-ironing apparatus according to claim 5, characterised in that the trimming means includes a trimming edge radially aligned with an edge of the groove, so that the bead immediately adjoins the free end of the trimmed cylindrical wall.

7. A one-piece, metal, cup-shaped container having a base and an integral elongate cylindrical wall, in which the cylindrical wall has been extended by wall-ironing and trimmed to provide a container of predetermined length, characterised in that the cylindrical wall has an integral, inner circumferential bead formed near the rim.

8. A container according to claim 7, characterised in that the bead adjoins the rim.

9. A container according to claim 7 or 8, characterised in that the bead has a greater axial dimension than radial dimension with respect to the cylindrical wall.

10. A container according to claim 9, characterised in that the radial dimension is 0.06 to 0.07 mm.

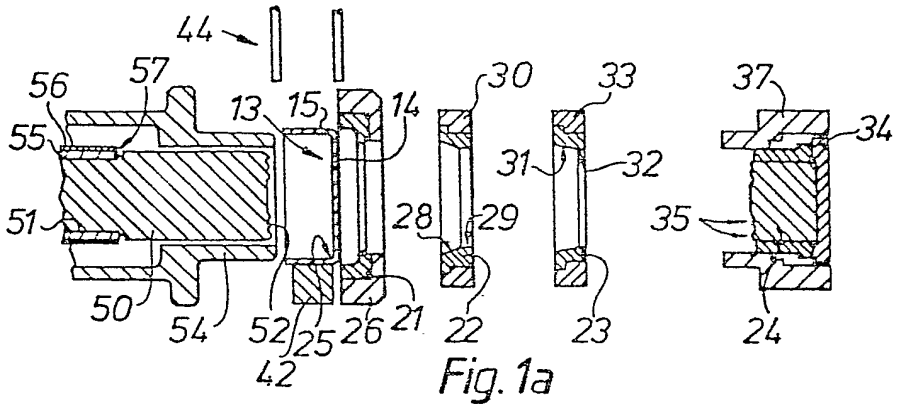

Fig. 1a

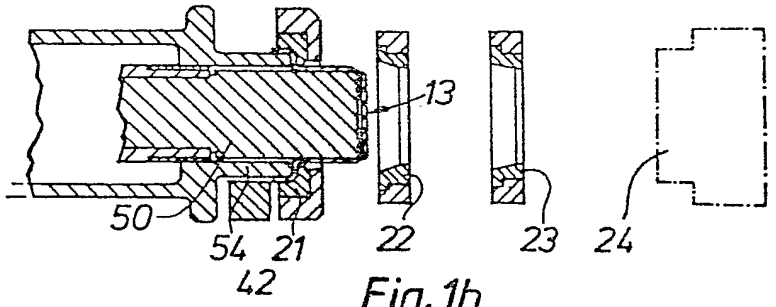

Fig. 1b

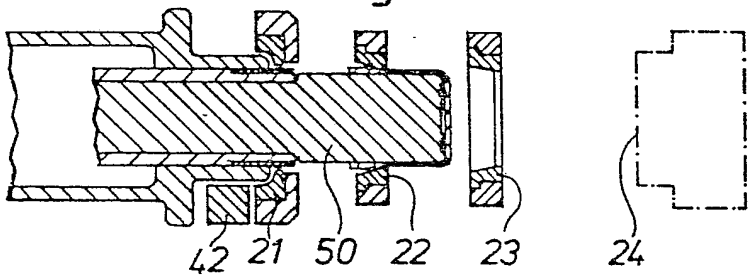

Fig. 1c

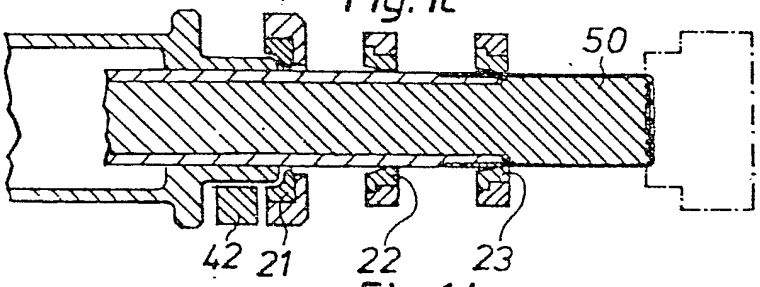

Fig. 1d

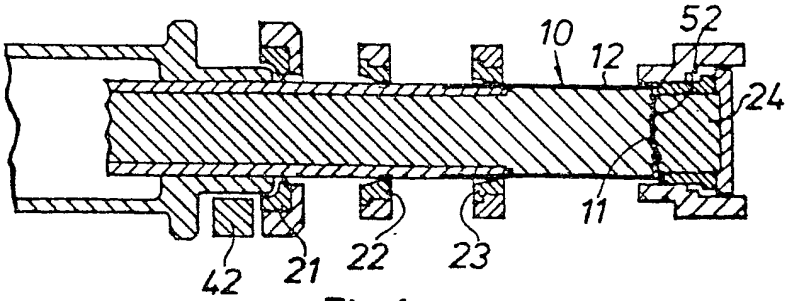

Fig. 1e

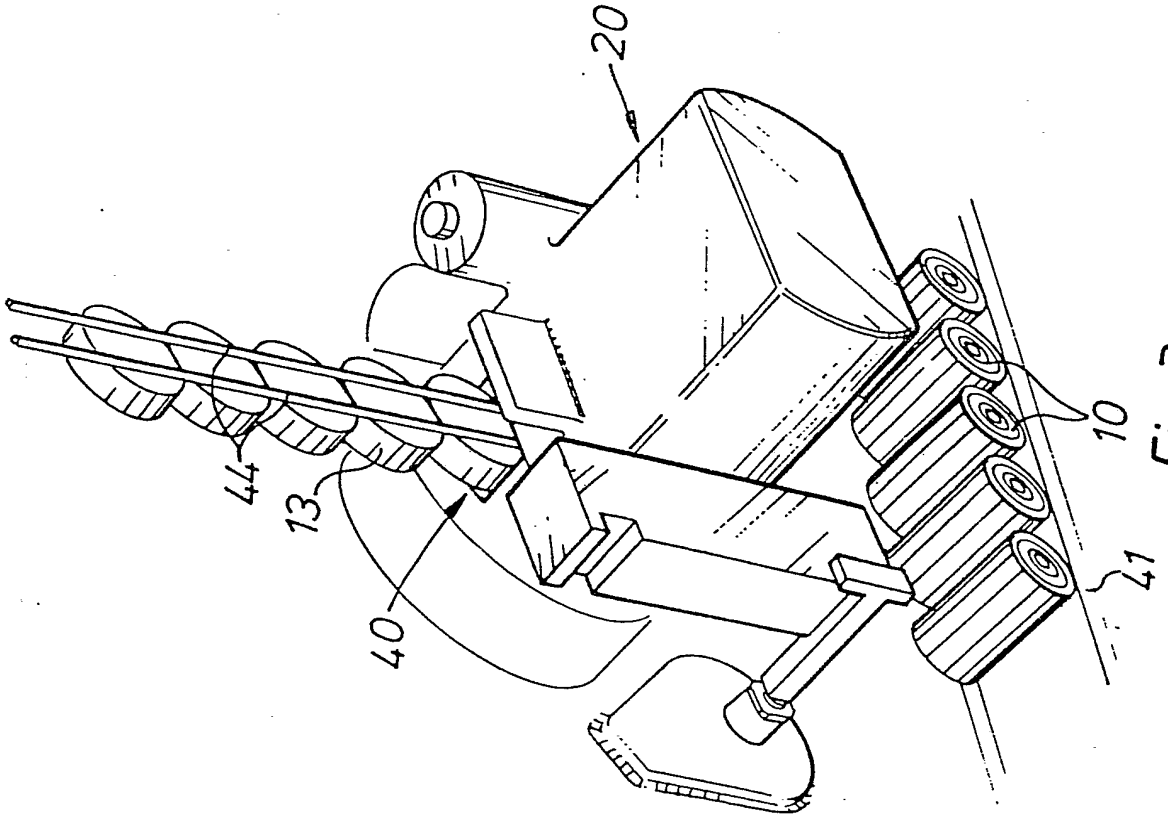

Fig.3

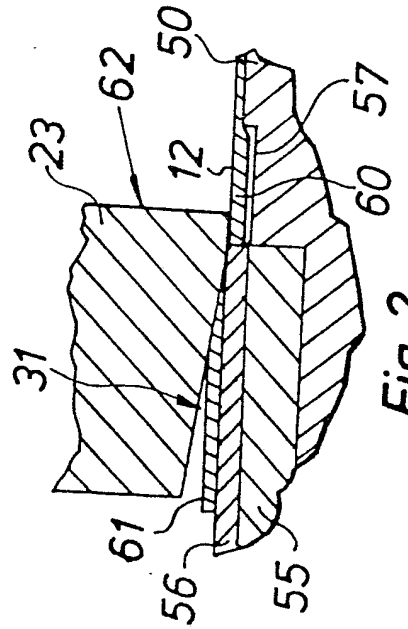

Fig.2

European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 80 30 0961.2

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	DE - A - 1 602 538 (RASSELSTEIN) * claims 1 to 4; fig. 4 to 6 *	1-3
X	DE - C3 - 1 527 947 (CONTINENTAL CAN CO.) * claim 1; fig. 2A *	1-3
	DE - A - 2 256 334 (WÜRTEMB. METALL-WARENFABRIK) * claims 1, 2; fig. 4 *	1,2
	DE - A1 - 2 503 828 (YOSHIZAKI) * page 6, fig. 1 *	1,2
	DE - C - 582 448 (PFAENDLER & CIE) * claim 1; fig. 1, 2 *	1,2
A	GB - A - 1 467 707 (TOYO SEIKAN KAISHA) * complete document *	
A	US - A - 3 610 018 (SWANSON et al.) * complete document *	

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CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

B 21 D 22/28
B 21 D 24/16
B 65 D 8/08

TECHNICAL FIELDS SEARCHED (Int.Cl.³)

B 21 D 22/00
B 21 D 24/16
B 65 D 8/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	10-07-1980	SCHLAITZ

EPO Form 1503.1 06.78

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.³)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	CH - A - 550 620 (KM-ENGINEERING) * complete document * ----		TECHNICAL FIELDS SEARCHED (Int. Cl.³)

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DOCUMENT-IDENTIFIER: EP 17434 A1

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INVENTOR-INFORMATION:

NAME	COUNTRY
MCKIE, RICHARD MCCORMICK	N/A
VARDY, EDWARD ANTHONY	N/A
WINTERTON, MICHAEL	N/A
HASKEW, MICHAEL	N/A
PRICE, FRANK	N/A
WHETTON, GEOFFREY	N/A
RHODES, PHILIP	N/A
COOK, JOHN ALAN	N/A
WARREN, JOHN KEITH	N/A

ASSIGNEE-INFORMATION:

NAME	COUNTRY
MARDON ILLINGWORTH	GB

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EUR-CL (EPC): B21D022/28 , B21D022/30

US-CL-CURRENT: 72/348

ABSTRACT:

CHG DATE=19990617 STATUS=O> A cup-shaped container is formed from a metal blank (13) by forcing the blank (13), carried by a mandrel (50) through a drawing die (21) to shape the blank (13) with a base (14) and an elongate cylindrical wall (15), and ironing dies (22,23) to thin and extend the cylindrical wall (15) along the mandrel (50). The mandrel (50) has circumferential a groove (57) into which metal is caused to flow during the ironing step and adjacent the groove (57) is a severing die (56) which co-operates with an ironing die (23) to trim the rim of the cylindrical wall (15) adacent the groove (57). The resultant container has an inner circumferential bead (60) at the rim, which strengthens the container and reduces the incidence of splitting.